Resistance of Dent Corn to *Basisporium gallarum* Moll.

By C. S. Reddy

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE
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SUMMARY

Injury by *Basisporium gallarum* is associated with cessation of translocation within the corn plant. It occurs at the time of germination, after normal maturity, and when plants die prematurely from cold or other causes.

Basisporium-infected seed dies within a few days after it is planted in soils slightly below the temperature range for germination. The organism kills the germ before active translocation sets in. Active translocation, in this case, means germination and germination marks a change in the embryo from neutral to acid reaction. Acid reaction in the cob was shown to be correlated with resistance to Basisporium infection. Therefore, the fact that the germinating kernel becomes resistant at the same time that the embryo becomes acid may mean that there is a similar correlation between acidity and resistance in the seed as has been shown between the acidity of the cob and resistance to Basisporium ear infection. Therefore, good field stands are correlated with warm soil temperatures which promote rapid germination and poor field stands with cold soil temperatures which make germination slow.

Seed treatments are most beneficial under conditions suitable to greatest injury by the organisms, namely, cold soil at time of germination.

Seed corn strains which germinate readily at low temperatures (below 11°C.) are injured little by *Basisporium gallarum*. Seed corn strains requiring high temperatures (above 11°C.) for germination are severely injured by *B. gallarum*.

Experiments on artificial inoculation of corn ears with *Basisporium gallarum* indicated that when natural inoculum was widespread the number of infected ears was not significantly increased by artificial wound inoculations. With or without artificial inoculation, susceptible ears became infected and the resistant ears did not. A similar experiment in a year when natural infection was much less (6 percent in check), gave an increase (9 percent in inoculated) following artificial inoculation.

The resistant ears are those having high hydrogen ion concentration in the cobs. The susceptible ones are those having low hydrogen ion cencentration in the cobs.

Cob reaction is an inherited character and promises a means of more easily breeding strains of corn resistant to Basisporium ear-rot.

The correlation between the ability to germinate at low temperature and the resistance to injury by the organism is the basis for breeding strains of corn resistant to seed rotting by *Basisporium gallarum* at time of germination.

Resistance of Dent Corn to *Basisporium gallarum* Moll.[1]

By Chas. S. Reddy

Basisporium dry-rot of corn was first described by Bubak and Kosaroff (3) in 1911. The first record of this disease in the United States was made in 1913 by Arzberger (1) in Ohio. He came to the conclusion that *Coniosporium gecevi* Bubak, synonym of *Basisporium gallarum* Moll. (10), was not a parasite and, therefore, could not cause a disease. Durrell (4) in 1925 first showed the significance of Basisporium as a serious disease of corn. He reported the effects of Basisporium on the ears, stalks and seed, as well as the action of Basisporium on tissues.

Mason (8) in 1927 made an intensive study of the genus Nigrospora Zimmermann (23, 14) and on the basis of priority placed the genus Basisporium (10) as a synonym of Nigrospora. Mason (8) and Savulescu (18) found two species of Nigrospora occurring usually on the same host plants, including corn, and with the same geographical distribution. These two species, *Nigrospora oryzae* (B. and Br.) Petch (2, 11) and *Nigrospora sphaerica* (Sacc.) (15, 16) Mason, which occur on corn, are similar except as to size of spores. The former measures 13-15 microns and the latter 15-20 microns. Mason (8), however, made no pathogenicity studies.

Experiments reported in this paper have dealt with the two species according to Mason. No attempt was made to separate the two species in the work reported here. For that reason, it seems desirable to retain the name, *Basisporium gallarum*, in this publication. Spore measurements during the investigations indicated a prevalence of the large spore form, but pure cultures were sometimes obtained in which the spore measurements indicated the small spore form. The separation of Nigrospora on corn into two species cannot be accepted until differences in symptoms and pathogenicity are established. The differences in spore size are too narrow in range to justify species classification without these differences being supported by other characters. It has been observed that a large spore form, when grown in pure culture, may show the small spore form.

The value of separating species of Nigrospora on corn is not clearly evident (9). *Coniosporium gecevi* Bubak (3) is a synonym of Nigrospora sphaerica because of the large spores. On account of the small spores Arzberger should have identified his organism

[1] The work reported in this bulletin has been done in the Plant Pathological Laboratory of the Iowa Agricultural Experiment Station under Purnell Project No. 95 on corn diseases. The author is indebted to Dr. I. E. Melhus, head of the Botany and Plant Pathology Section, for suggesting the problem, for many valuable suggestions and for criticism and aid in preparing the manuscript.

as *C. gecevi* Saccardo (17) now placed by Mason as a synonym of *Nigrospora oryzae.* Durrell (4) considered his fungus identical with that of Arzberger, but his spore measurements of 13-18 microns show it to be somewhat intermediate to the two species.

Savulescu and Rayss (18, 19, 20), the most recent investigators of Basisporium dry rot of corn, seemed to deal with *N. oryzae* only. They found that spore measurements ranged from 9-16 microns and the most frequent values were 13-15 microns. These investigators have published on geographic distribution, and on morphological, systematic (18) and certain biological characters (19, 20) of *N. oryzae.* They report no infection by this organism of Rumanian maize (*Zea mays* var. *vulgata*) but heavy infection of *Zea mays* var. *dentiformis* grown on the Danube plain.

Savulescu and Rayss (19) found that the vector agent is always the Angoumois grain moth, *Sitotroga cerealella* Oliv., and that infection is influenced by high humidity and the stage of maturity of the corn. From our results it seems doubtful that this insect is an important vector of this pathogene in Iowa.

That the relative importance of *Basisporium gallarum* is greater than was thought has been demonstrated by studies reported in this paper which show more clearly its prevalence and destructiveness in causing an ear rot and a seed-borne disease. It is the purpose of this paper to record studies of Basisporium dry-rot relating to its effect on the seed and the seedling, including data on the possibilities of reducing the injury in this stage of the disease by seed treatment, resistant strains, or time of planting. In addition, a report is made of a simple chemical test which may be useful to breeders in determining the resistance or susceptibility of inbred strains of corn to Basisporium dry-rot.

EFFECT OF TEMPERATURE AND OF SEED TREATMENT AT TIME OF GERMINATION

It is well recognized that kernels infected by Basisporium dry-rot are usually light in weight, shrivelled and discolored. Such kernels are seldom dead, and under favorable conditions they produce plants that may be either normal or stunted. In experiments to determine the effect of the organism on seedling corn plants grown from seed inoculated with spores or mycelium, no visible symptoms such as seedling blight, lesions, or dwarfing were regularly obtained. Likewise, inoculations of seedlings by infesting the soil with Basisporium growing on sterilized grain gave negative results. Further laboratory trials using naturally-infected seed showed no appreciable symptoms of Basisporium infection in the developing plants. In field trials using Basisporium-infected seed in comparison with healthy seed, a decrease in stand did occur in some years but not in others. These

preliminary laboratory and field trials indicated that temperature might be an important influence on the germination of Basisporium-infected seed.

EFFECT OF TEMPERATURE UPON GERMINATION OF HEALTHY AND DISEASED SEED

Two lots of seed were made up from healthy hybrid seed and one from diseased seed. This hybrid was the first cross of two inbred lines of yellow dent corn, the mother parent being very susceptible to Basisporium ear-rot. The materials of the experiment consisted of six groups of five cups (12-ounce paper dairy cups), each cup containing 15 kernels. Half the disease-free seed was inoculated by sprinkling ground Basisporium-infected cob on the planted seed before it was covered. On the other half, used for the check, ground disease-free cob was sprinkled in a like manner. Three sets of five cups each, treated as described, were exposed to temperatures ranging from 11 to 14°C. and a similar group to temperatures ranging from 16 to 23°C. The emergence was recorded 18 days after the corn was planted and the green weights 3 days later. The results of this experiment are set forth in table I.

TABLE I. EFFECT OF ARTIFICIAL AND NATURAL INOCULATION OF DENT CORN WITH *BASISPORIUM GALLARUM*. AMES, IOWA, 1929.

Seed	Temperature range					
	11—14°C.			16—23°C.		
	Emergence	Green weight	Increase or decrease in weight	Emergence	Green weight	Increase or decrease in weight
	Pct.	Gm.	Pct.	Pct.	Gm.	Pct.
Disease-free (Check)	83	117	....	89	143	....
Inoculated	86	127	+8.5	90	143	0
Naturally-infected	60	78	—33.3	64	75	—47.5

The data in table I show that no injury resulted from the artificial inoculation of disease-free seed with *Basisporium gallarum*. The data also show that naturally-infected seed was not equal to the disease-free seed in stands or green weights at either temperature.

PRELIMINARY SEED TREATMENT EXPERIMENTS

Further preliminary experiments showed that Basisporium-infected seed corn could be benefited by seed treatment. Tables II and III contain data on the effect of different seed treatment materials as determined by weight of undried seedlings in ex-

periments terminated 2 to 3 weeks after planting. In the experiment reported in table II the temperature range was 11-14°C. during germination, and each unit consisted of plants from 50 kernels.

TABLE II. WEIGHTS OF SEEDLINGS FROM TREATED AND NONTREATED BASISPORIUM-INFECTED SEED CORN GERMINATED AT 11–14° C. AND PERCENTAGE INCREASES (OVER THE MEAN WEIGHT OF ALL THE CHECKS) FOLLOWING THE TREATMENTS. AMES, IOWA, 1929.

	Treatment						
	Merko	Check	Sem. Jr.	Check	Trial dust No. 31	Check	Trial dust No. 31
Total green weight in grams	82	68	82	52	92	58	100
Percentage increase	38.3		38.3		55.2		68.6

In the experiment reported in table III a heavily infected lot of seed containing many dead kernels was used, and the temperature ranged from 22°C. to freezing. The freezing occurred when the seedlings were about 2 inches in height. They were washed and weighed immediately after exposure to freezing temperatures.

TABLE III. WEIGHTS AND PERCENTAGE EMERGENCE OF SEEDLINGS FROM TREATED AND NONTREATED BASISPORIUM-INFECTED SEED CORN AND PERCENTAGE INCREASES IN GREEN WEIGHTS FOLLOWING THE TREATMENTS.

Treatment	Emergence from 45 kernels		Total green weight	Increase
	Number	Percent	Grams	Percent*
Check	9	20	30	..
Merko	28	62	40	50
Semesan Jr.	23	51	39	46
Sterocide	20	44	38	43
Check	12	27	25	..
No. 31 (Trial dust)	22	49	42	58
Corona 156	22	49	35	31
58a (Trial dust)	20	44	40	50
Check	15	33	25	..

* Increase in weight over mean of three checks.

The data in tables II and III show that Basisporium-infected seed is benefited in germination and the green weight of seedlings is increased when the seed is treated with a dust disinfectant.

NATURE OF THE INJURY FROM THE ORGANISM

In the experiments, reported in tables I, II and III and in later similar experiments, attempts were made to determine the nature of the injury caused by *Basisporium gallarum*. It was observed that there was an absence of a mesocotyl injury, such

as is caused under similar conditions by *Diplodia zeae* (Schw.) Lev. (6, 12) or *Gibberella saubinetii* (Mont.) Sacc. (6). In exceptional cases where the mesocotyl seemed to be invaded early (less than 3 weeks after germination), isolations from the lesions showed a close association with other organisms. Sometimes these were other dry-rot organisms; but *Cephalosporium acremonium* Corda (13), and other organisms have been found closely associated with *B. gallarum* under these conditions.

Although it is thought that *B. gallarum* does not cause lesions in the growing tissues during these early stages, the organism grows on other parts of the seed, especially the pericarp and adjacent tissues. It is probable that the young plant is injured very little by the presence of the organism in these tissues. However, if the scutellum was invaded during the ripening period in the preceding fall, then, even under the best conditions for growth, some loss of vigor will result. Low temperatures favor the Basisporium organism. As will be shown later, if the temperature is just below that at which the corn can germinate the organism can attack the embryo, and subsequent germination, even under favorable conditions, is impossible because the embryo is rotted. High temperatures favor the plant in this competition, so that Basisporium-infected seed on high temperature germinators often produce as vigorous seedlings as do disease-free seed.

The injury in the early seedling stage, therefore, is probably confined to killing the seed before it germinates. Toward the end of the seedling stage, before the permanent crown roots have made the plant entirely independent of the seed and primary roots, a rotting often has been observed at the point where the scutellum is attached to the plant.

Table IV shows that at the 2-foot-high stage of development the primary root systems of about two-thirds of the corn plants from both healthy and Basisporium-infected seed were functioning moderately well; but 26.9 percent of the primary roots from the diseased seed, as compared with 4.4 percent from the healthy seed, were functioning only slightly or not at all. At this time nearly all the food had disappeared from the kernel, leaving the pericarp blackened by the growth of the fungus. Whether the late rot at the point where the scutellum is attached to the plant is caused by the direct penetration of *Basisporium gallarum* before the seed was ripened in the fall or after the seed was planted, or by absorption of poisonous staling products from the growth of the organism in the kernel, has not been determined. Isolations from these lesions often showed the presence of the organism, but it may have entered after the tissue was killed. This interference with the functioning of the primary root system seldom occurs soon enough to cause seedling blight. The growth of the plant under these conditions becomes depen-

TABLE IV. FUNCTIONING OF PRIMARY ROOT SYSTEMS OF CORN PLANTS 2 FEET IN HEIGHT AS DETERMINED BY THE CONDITION OF THE MESOCOTYLS.

Seed	Condition of primary root system					
	Good	Intermediate	Bad	Good	Intermediate	Bad
	No.	No.	No.	Percent	Percent	Percent
Nearly disease free	27	61	4	29.3	66.3	4.4
Basisporium-infected	13	66	29	12.0	61.1	26.9

dent on the permanent crown roots alone and in some degree is retarded. It is possible that seed treatment protects against this late effect only moderately well, and may be the explanation of why Basisporium-infected seed, even when treated, does not yield as well as good seed. Treated Diplodia-infected seed often yields almost as much as good seed.

EFFECT OF TEMPERATURE AND SEED TREATMENTS UPON GERMINATION OF INFECTED SEED

The effect of temperature on germination of Basisporium-infected seed was determined by several laboratory and greenhouse experiments. Culture tests were conducted at different temperatures with treated and nontreated Basisporium-infected seed, using 10 kernels to each cup and five cups (50 kernels) as the minimum unit. Table V presents the data on emergence from two such tests. The seed of lot I was from severely infected ears and contained many dead kernels. Lot II was from lightly infected ears with practically no dead kernels.

TABLE V. PERCENTAGE EMERGENCE OF TWO LOTS (LOT I WAS HEAVILY AND LOT II LIGHTLY INFECTED WITH *BASISPORIUM GALLARUM*) OF NONTREATED AND TREATED SEED CORN AT DIFFERENT TEMPERATURES.

Treatment	Seed lot I		Seed lot II	
	11—14°C.	15—23°C.	15—23°C.	25—35°C.
Merko	58	78	86	98
Semesan Jr.	48	62	98	98
Sterocide	32	72	96	98
Check	18	46	74	90
No. 31 (Trial dust)	44	72	98	96
Corona 156	42	70	90	98
Check	26	48	76	96
Average nontreated seed	22	47	75	93
Average treated seed	45	71	94	98
Percentage increase following treatment	104.5	51.1	25.3	5.4

The data in table V show that the organism had little effect on emergence of the plants at the high temperature (25-35°C.)

and much effect at the low temperature (11-14°C.). At the medium temperatures the effects were intermediate. Seed treatments increased the emergence 104.5, 51.1, 25.3 and 5.4 percent, respectively. The increase depended on the severity of the seed infection and on the temperature at which the experiment was conducted.

EFFECT OF SEED TREATMENT AND TEMPERATURE UPON SEEDLINGS

The plants from the preceding experiment (table V) were washed free from sand, and green weights were obtained. The data are shown in table VI.

TABLE VI. EFFECT OF SEED TREATMENT AND TEMPERATURE ON THE GROWTH OF BASISPORIUM-INFECTED DENT CORN AS DETERMINED BY GREEN WEIGHT OF SEEDLINGS.

Treatment	Seed lot I		Seed lot II	
	11—14°C. Grams	15—23°C. Grams	15—23°C. Grams	25—35°C. Grams
Merko	88	93	92	128
Semesan Jr.	91	84	87	138
Sterocide	89	85	102	124
Check	53	64	76	102
No. 31 (Trial dust)	90	96	105	137
Corona 156	78	90	93	124
Check	57	68	64	112
Average nontreated seed	55	66	70	107
Average treated seed	87	90	96	130
Percentage increase following treatment	58.2	36.4	37.2	21.5

Table VI shows that seed treatment increased the green weight of seedlings from Basisporium-infected seed. The increases were 58.2, 36.4, 37.2 and 21.5 percent, respectively. In agreement with the emergence data in table V, the greatest increase in green weight was at the low temperature and the least increase at the high temperature. On the other hand, the percentage of increase in green weight of seedlings from heavily infected seed (lot I) was less than the percentage of increase in emergence. From lightly infected seed (lot II) the increase in green weight of seedlings was more than the percentage increase in emergence.

Striking results were obtained in a seed treatment experiment in which Basisporium-infected F1 seed from a single ear was used. In this experiment 40 kernels instead of 50 were used as a unit. The temperature during the first week ranged from a little above freezing to 15°C., but was usually between 10° and 12°C. After the first week the experiment was moved into a greenhouse with a prevailing temperature of 25°C. The data on emergence and green weight of plants are shown in table VII. One treated unit and the check are illustrated in fig. 1.

Table VII and fig. 1 show that the untreated Basisporium-

Fig. 1. Results of planting Basisporium-infected seed, nontreated (left) and treated (right), in soil averaging for the first week approximately 12° C. and later 25° C. (Data from table VII.)

infected kernels were killed by the growth of the organism under conditions not suitable for germination. Four of the five seed treatments prevented the fungus from killing the seed, and almost perfect stands resulted.

TABLE VII. EFFECT OF SEED TREATMENT ON BASISPORIUM-INFECTED SEED EXPOSED TO COLD SOIL CONDITIONS DURING THE FIRST WEEK AFTER PLANTING, 1929.

Treatment	Percentage emergence		Green weight in grams
	Early	Final	
No. 31 (Trial dust)	70	93	70
Semesan Jr.	53	98	68
58 ade (Trial dust)	48	98	70
575* (Trial dust)	55	95	58
X (Trial dust)	0	20	52
Check*	0	0	27**

* Illustrated in fig. 1.
** Weight of dead kernels.

EFFECT OF TEMPERATURE ON TREATED AND UNTREATED SEED

An attempt was made to show the effect of temperature alone, and with seed treatment, on the early growth of Basisporium-infected dent corn seed by planting 10 infected kernels in each of 80 dairy cups and exposing them in various ways to different controlled temperatures. Treated seed was planted in half the number of cups. Five pairs (one cup with seed treated and one not treated) of cups were placed in each of four chambers, using 40 of the cups. The other 40 were used in a succeeding experi-

ment. The four chambers had the following temperatures, respectively, 7°, 11°, 14° and 24°C. After 2 days one pair was withdrawn from each chamber. On each succeeding day another pair was withdrawn from each chamber until the five pairs were withdrawn. By this procedure planted Basisporium-infected seed corn was immediately exposed to different temperatures for different lengths of time. After the exposures all the plants were held in the same room (16-23°C.) until the data were recorded (table VIII).

TABLE VIII. EMERGENCE AND GREEN WEIGHT OF CORN FROM BASISPORIUM-INFECTED SEED, TREATED AND NONTREATED, GROWN IN SAND AT 7°, 11°, 14°, OR 24° C. FOR 2 TO 6 DAYS AND AT ROOM TEMPERATURE FOR THE REMAINDER OF THE PERIOD. AMES, IOWA, 1931.

2 to 6 days exposure at	Basisporium-infected seed corn	Total average stand in percent	Percentage increase following treatment	Grams green weight	Percentage increase following treatment
7°C.	Nontreated	56	—	61.0	—
"	Treated	62	10.7	69.3	13.6
11°C.	Nontreated	60	—	68.8	—
"	Treated	72	20.0	82.8	20.3
14°C.	Nontreated	58	—	64.0	—
"	Treated	72	24.1	68.0	6.3
24°C.	Nontreated	80	—	87.0	—
"	Treated	68	—15.0	84.0	—3.4

The data in table VIII indicate that seed treatment is of more benefit to emergence of Basisporium-infected seed corn at 11° and 14°C. than at a higher or lower temperature. Green weight of seedlings was benefited most at the 11°C. temperature. It was observed that exposures of more than 3 days were more injurious to the seedlings than those of less than 3 days.

In another part of this experiment a uniform exposure (4 days) was given at temperatures 7°, 11°, 14° and 24°C. These 4-day exposures were begun at daily intervals of from 2 to 6 days after planting. Before and after the exposures the experimental materials were held at room temperatures varying from 16° to 23°C. The appearance of the plants and the data obtained are shown in figs. 2 and 3.

In general it appears that seed treatment of Basisporium-infected seed is of much benefit to the seedlings when low temperature conditions last 4 days. At the two lower temperatures seed treatment materially increased both stands and green weights (stands: 18.5 and 32.3 percent; green weights: 35.9 and 45.3 percent). At the two higher temperatures stands were affected little (decrease 2.7 and increase 5 percent), but the green weights were materially increased (13.3 and 36.5 percent). It was stated earlier in the paper that Basisporium was most injurious at temperatures at which the organism could grow

NOT TREATED

Elapsed time after planting before 4-day exposures.

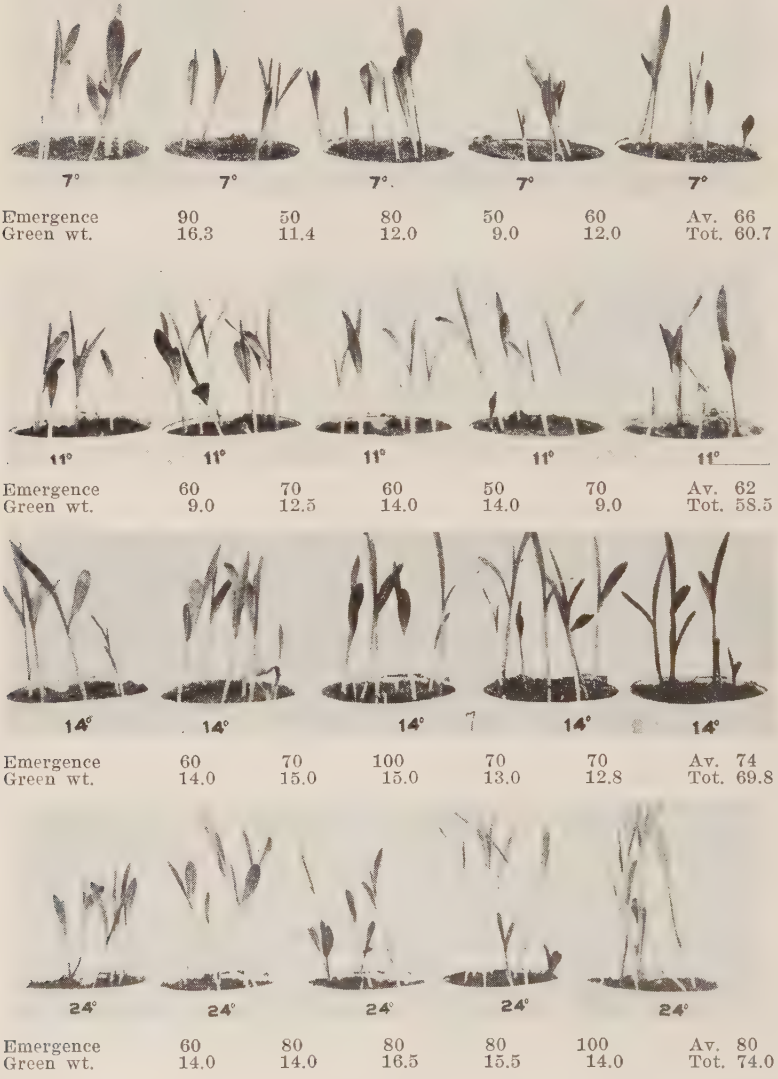

Fig. 2. Yellow dent seed corn grown in sand and naturally infected with *Basisporium gallarum* given 4-day exposures to temperatures of 7°, 11°, 14° or 24° C. after being held for different periods (2–6 days) at room temperature (16°–23° C.).

TREATED

Elapsed time after planting before 4-day exposures.

	2 Days	3 Days	4 Days	5 Days	6 Days	
	7°	7°	7°	7°	7°	
Emergence	70	90	80	60	90	Av. 78
Green wt.	15.0	17.5	16.0	16.0	18	Tot. 82.5
	11°	11°	11°	11°	11°	
Emergence	90	90	80	70	80	Av. 82
Green wt.	18.0	19.0	19.0	13.5	15.5	Tot. 85.0
	14°	14°	14°	14°	14°	
Emergence	60	80	80	60	80	Av. 72
Green wt.	15.5	15.5	18.3	13.8	16.0	Tot. 79.1
	24°	24°	24	24°	24°	
Emergence	80	80	90	80	90	Av. 84
Green wt.	20.0	21.0	19.0	20.0	21.0	Tot. 101.0

Fig. 3. Treated yellow dent seed corn grown in sand and naturally infected with *Basisporium gallarum* given 4-day exposures to temperatures of 7°, 11°, 14° or 24° C. after being held for different periods (2–6 days) at room temperature (16°–23° C.).

but at which the seed would not germinate. In agreement with this, killing or inhibiting the growth of the fungus (seed treatment) at the 11°C. temperature gave the greatest increase in stand and green weight. The data from table VIII and figs. 2 and 3 are summarized in table IX.

TABLE IX. SUMMARY OF DATA FROM TABLE VIII AND FIGS. 2 AND 3.

Temperature °C.	Basisporium-infected seed	Data from table VIII		Data from figs. 2 and 3		Sum of data from table VIII and figs. 2 and 3		Percentage increase following treatment	
		Percentage stand	Grams green weight	Percentage stand	Grams green weight	Pctg. average stand	Total grams green weight	Stand	Green weight
7°	Nontreated	56	61.0	66	60.7	61	121.7	—	
"	Treated	62	69.3	78	82.5	70	151.8	14.8	24.7
11°	Nontreated	60	68.8	62	58.5	61	127.3	—	
"	Treated	72	82.8	82	85.0	77	167.8	26.2	31.8
14°	Nontreated	58	64.0	74	69.8	66	133.8	—	
"	Treated	72	68.0	72	79.1	72	147.1	9.1	9.9
24°	Nontreated	80	87.0	80	74.0	80	161.0	—	
"	Treated	68	84.0	84	101.0	76	185.0	—5.0	14.9

For purposes of comparison paired lots of treated and nontreated Diplodia-infected seed were included in the preceding experiment at one of the four temperatures, namely, 7°C. Diplodia dry-rot, like Gibberella dry-rot, has a seedling blight stage in contrast with the almost complete lack of such a stage in Basisporium dry-rot disease. The appearance and data of the seedlings from Diplodia-infected seed are presented in fig. 4 and table X. The last two paired lots in fig. 4 depicting 4-day exposures were by chance not 4-day exposures, but 10 and 12-day exposures, respectively.

TABLE X. SUMMARY OF DATA FROM FIG. 4.

Diplodia-infected seed	Average of data from				Percentage increase following treatment	
	Exposures to 7°C. immediately after planting		Deferred 4-day exposures to 7°C.			
	Percentage stand	Grams green weight	Percentage stand	Grams green weight	Stand	Green weight
Nontreated	56	47.0			—	—
Treated	76	72.6			35.7	54.5
Nontreated			52.5	40.7		
Treated			87.5	59.3	66.7	45.7

Figure 4 shows numerous blighted seedlings in contrast with those shown in figs. 2 and 3, in which the seedlings are from Basisporium-infected seed. Figure 4 and table X show that in agree-

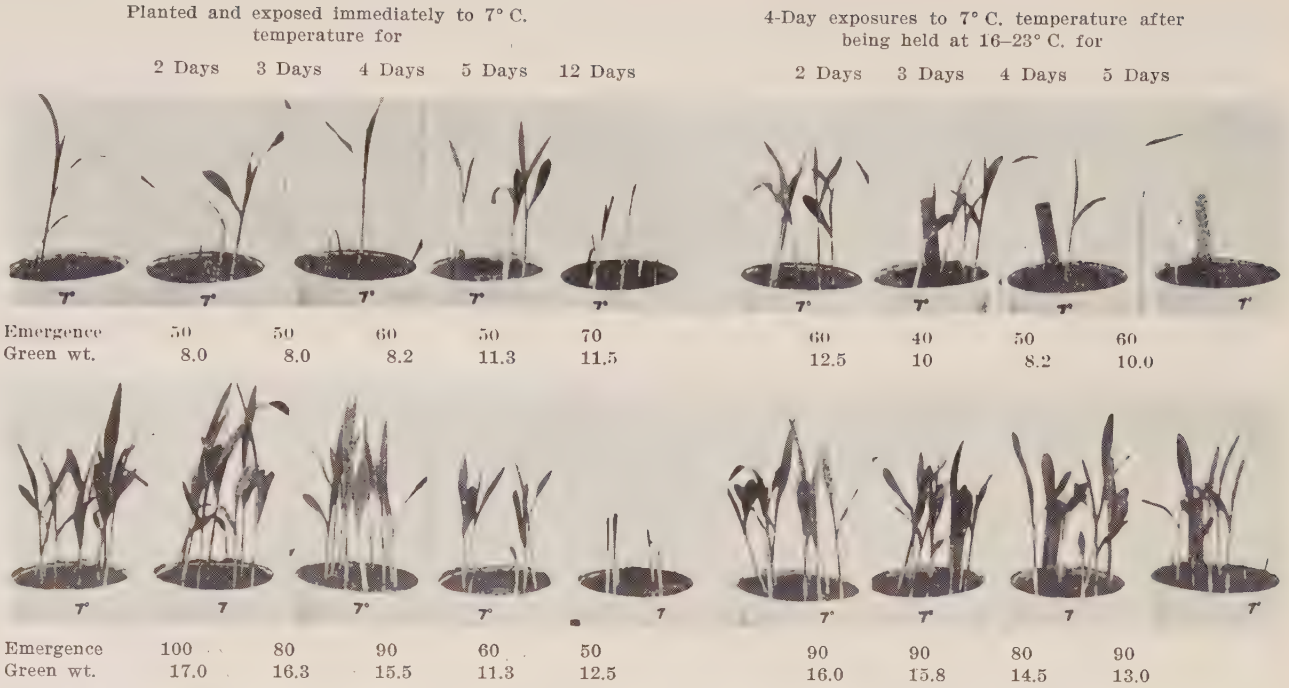
Planted and exposed immediately to 7° C. temperature for
2 Days
3 Days
4 Days
5 Days
12 Days
4-Day exposures to 7° C. temperature after being held at 16–23° C. for
2 Days
3 Days
4 Days
5 Days
7°
Emergence 50 50 60 50 70 60 40 50 60
Green wt. 8.0 8.0 8.2 11.3 11.5 12.5 10 8.2 10.0
Emergence 100 80 90 60 50 90 90 80 90
Green wt. 17.0 16.3 15.5 11.3 12.5 16.0 15.8 14.5 13.0

Fig. 4. Not treated (upper row) and treated (lower row) yellow dent seed corn naturally infected with *Diplodia zeae* grown in sand at 7° C. for different periods.

ment with the data in table IX seed treatment in general has benefited diseased seed (stands increased 35.7 and 66.7 percent and green weights increased 54.5 and 45.7 percent). In this instance the seed infected with *Diplodia zeae* was benefited more than the seed infected with *Basisporium gallarum*. The benefit is strikingly evident when the adverse conditions continue less than 5 days. The treated seed lot at the extreme right in fig. 4 was exposed to the low temperature for 12 days and, in spite of seed treatment, numerous blighted plants appeared.

These temperature experiments showed that *Basisporium gallarum,* like the other two dry-rot fungi, *Diplodia zeae* and *Gibberella saubinetii,* is very destructive to seed germinated at low soil temperatures; but that *B. gallarum,* unlike the other two dry-rot fungi, does not cause seedling blight. It is, at this stage in the corn plant's development, a seed-rotting fungus and appears to be most destructive at about 11°C. The difference in the effects of the same temperature on Basisporium-infected seed, as shown by the data in tables VII and IX, may have its explanation in the fact that F1 seed was used in one case and open-pollinated in the other. If the infected F1 seed required a somewhat high temperature for germination, it would be expected that *B. gallarum* would kill all the seed, which it did (table VII). If the open-pollinated seed varied in its temperature requirements for germination, it would be expected that only the kernels requiring high temperatures for germination would be killed. (See 11°C. temperature in table IX.)

These experiments showed that beneficial effects could be expected from a seed treatment that would check the growth of *Basisporium gallarum* at the critical temperature range (about 11°C.). If the strain of corn germinates readily at or below this critical temperature, however, injury by seed rotting caused by this organism would be greatly reduced. This relationship may be the explanation for our previous observation that "varieties of corn differ in the degree to which they are benefited by seed treatment" (5) and points to an avenue of attack on this problem by corn breeders. The strain of corn that is resistant during germination is likely to be one that can germinate at or below 10°C.

FIELD EXPERIMENTS

Data from field experiments gave support to the interpretation of the laboratory and greenhouse experiments.

In 1930 Basisporium-infected dent corn was used in making eight plantings at intervals between April 22 and June 13. In the first, third and fourth plantings 342, 7,000 and 1,125 kernels, respectively, were used. In each of the other plantings 75 kernels were used. The mean of the maximum and minimum daily air temperatures was used as an indication of the soil temperatures, and the mean for the first 5 days succeeding planting was con-

TABLE XI. DATA ON TEMPERATURES AND FIELD STANDS FROM UNTREATED BASISPORIUM-INFECTED SEED. AMES, IOWA, 1930.

Average* daily temp. °C.	Temperature for 5-day period after planting	Field stand percentage	No. of plants in trial	Average* daily temp. °C.	Temperature for 5-day period after planting	Field stand percentage	No. of plants in trial	Average* daily temp. °C.	Temperature for 5-day period after planting	Field stand percentage	No. of plants in trial
April				May				June			
17 11.11				1 21.67				1 18.61			
18 10.00				2 17.22				2 21.67			
19 7.22				3 17.22	19.2	74	5160	3 22.78			
20 6.67				4 20.00				4 23.05			
21 7.22				5 23.89				5 19.17			
22 6.11	6.8	59	202	6 21.11				6 15.04	16.0	67	50
23 6.11				7 13.89				7 12.78			
24 5.56				8 15.04				8 15.04			
25 6.11				9 21.67				9 19.44			
26 10.00				10 21.11				10 17.78			
27 12.78				11 17.78				11 16.95			
28 11.11	17.2	73	55	12 15.04	12.2	61	684	12 16.39			
29 18.33				13 13.33				13 24.16	20.6	85	64
30 17.78				14 10.56				14 21.39			
				15 12.22				15 21.67			
				16 10.00				16 18.89			
				17 5.56				17 16.67			
				18 6.11	15.0	68	51				
				19 11.11							
				20 16.11							
				21 23.33							
				22 18.33							
				23 13.89							
				24 12.78							
				25 16.67							
				26 17.78							
				27 22.22							
				28 18.89	14.9	79	59				
				29 11.11							
				30 11.67							
				31 14.44							

* Mean of maximum and minimum air temperatures.

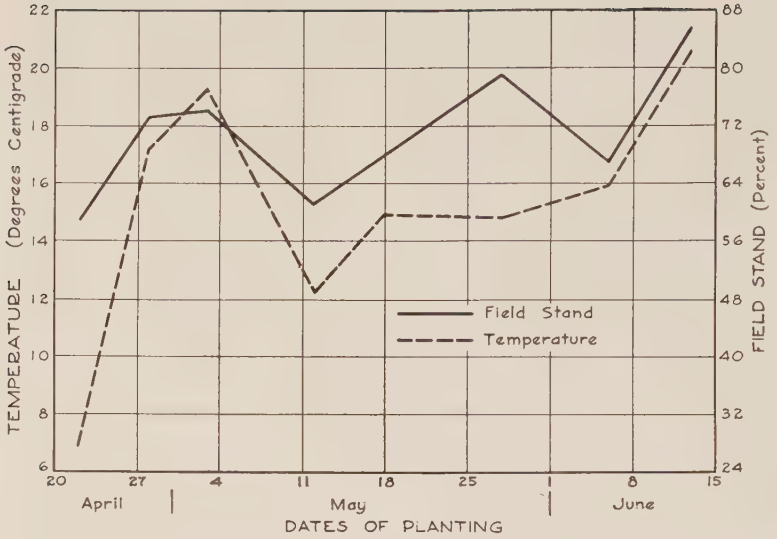

Fig. 5. Field stands from Basisporium-infected seed and temperatures at eight dates of planting, 1930.

sidered the most important temperature condition affecting the relation of the organism to the seed. Table XI and fig. 5 show the relations of field stands from Basisporium-infected seed to the temperatures prevailing at the time of planting.

Table XI and fig. 5 show that low temperatures are associated with low field stands from Basisporium-infected seed and that proportionately more seeds produce plants as the temperature rises. The only exception occurred in the May 28 planting, probably because of using too few seeds.

Table XII presents in more detail the data from the May 3 and May 12 plantings together with the effect of seed treatment at the two dates.

Table XII shows that a better stand (73.7 percent) was produced in the earlier planting at a warm temperature (19.2°C.) than (60.8 percent) in the later planting at a cooler temperature (12.2°C.). Basisporium dry-rot was more injurious at the lower temperature, making it possible for seed treatment to be of more benefit at the lower temperature (22.7 percent) than at the higher temperature (7.8 percent).

These temperature relations are also the basis for explanation of the variation in benefit to stands and yields derived from treating Basisporium-infected seed used in experiments conducted in 1927, 1928 and 1929—table XIII and fig. 6.

TABLE XII. FIELD STANDS FROM TREATED AND NONTREATED BASISPORIUM-INFECTED SEED CORN PLANTED IN WARM AND MODERATELY COLD SOILS, 1930.

Number kernels per hill	Emergence Not treated		Increase following treatment	
	Number	Percent	Number	Percent
Warm soil (average air temperature* 19.2° C.) planted May 3				
2	352	70.4	47	13.4
3	577	76.9	21	3.6
3	509	67.9	37	7.3
4	719	71.9	55	7.7
5	935	74.8	43	4.6
6	1,193	79.5	84	7.0
5	875	69.9	116	13.3
Summary.....	5,160	73.7	403	7.8
Cold soil (average air temperature* 12.2° C.) planted May 12				
3	222	59.2	55	24.8
3	226	60.3	59	26.1
3	236	62.9	41	17.4
Summary.....	684	60.8	155	22.7

* Mean maximum and minimum air temperatures for 5 days succeeding planting.

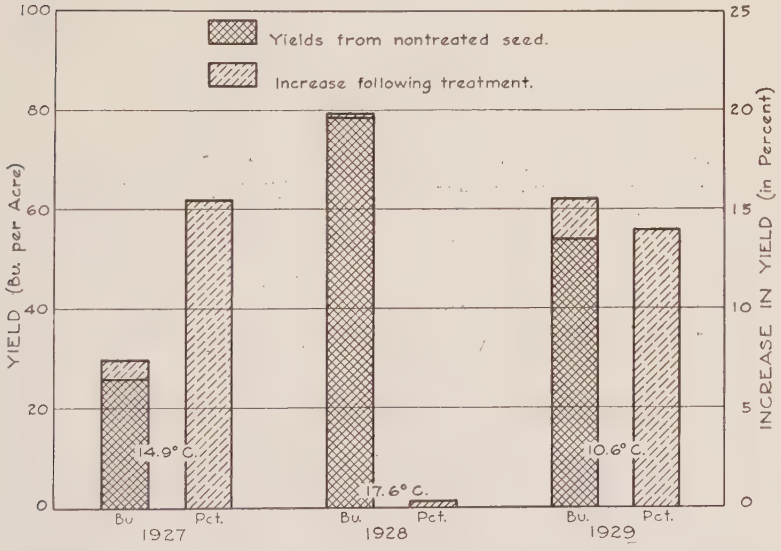

Fig. 6. Increases (1927 and 1929) following seed treatment of Basisporium-infected seed corn are associated with low temperatures at time of planting. (Data from table XIII.)

TABLE XIII. EFFECT OF SEED TREATMENT ON FIELD STANDS AND ACRE YIELDS FROM BASISPORIUM-INFECTED YELLOW DENT SEED CORN. AMES, IOWA, 1927, 1928 AND 1929.

Date planted and temperature*	Seed treatment	Field stand	Increase in stand following treatment	Mean acre yield	Increase or decrease in acre yield following treatment		Odds**
		Percent	Percent	Bushels	Bushels	Percent	
May 14, 1927	Check	64.7		26.5			
	Bayer dust	77.5	19.8	31.7	5.2	19.6	9999 :1
	Sem. Jr.	78.6	21.4	30.6	4.1	16.1	1666 :1
14.9°C.	Sterocide (double strength)	75.4	16.5	28.8	2.3	9.0	8 :1
	E2C+	78.4	21.2	31.1	4.6	18.0	73 :1
	Merko	79.1	22.3	30.9	4.4	16.6	416 :1
May 5, 1928	Check			81.6			
	Bayer dust	71.56	1.3	82.0	+0.4	+0.5	1 :1
	Sem. Jr.	73.34	3.8	78.0	—3.6	—4.4	15 :1
17.6°C.	F13	74.78	5.7	78.5	+1.4	+1.8	2 :1
	Check			77.1			
	Merko	70.34	—0.3	79.0	+1.9	+2.5	4 :1
	Sterocide	74.45	5.3	80.2	+1.9	+2.4	5 :1
	Check			78.3			
	Check av.	70.67		79.0			
May 4, 1929	Check	62.9		54.3			
	Sem. Jr.	67.7	7.6	58.6	4.3	7.9	13 :1
10.6°C.	Trial dust (575)	76.0	20.8	64.9	10.6	19.5	9999 :1
	Sterocide (¾ strength)	71.8	14.1	63.0	8.7	16.0	9999 :1
	Merko	71.2	13.2	59.4	5.1	9.4	29 :1
	$Hg(CN)_2$ —3½%	76.3	21.3	63.4	9.1	16.8	9999 :1

* Mean air temperature for 5 days following planting.

** Student's method; 10 replications in each experiment.

Table XIII and fig. 6 show that field stands were poor and benefits from seed treatment large in 1927 (10) and 1929 when plantings were made in cold soils, and that stands were good and the benefit from seed treatment was not significant in 1928 when planting was made in warm soil.

In general, the preceding data have shown that the lots of Basisporium-infected seed corn used produced poor stands when they were planted in cold soils and good stands when they were planted in warm soils. The low temperature at which *Basisporium gallarum* is most injurious is far below its optimum and very close to its minimum temperature for growth. Therefore, it seems likely that the organism injures the seed more or less, not because the organism is favored by low temperatures, but because the seed is at a disadvantage in withstanding attack. How badly the seed is at a disadvantage in soil of low temperature may depend on the strain of corn, because some strains of corn germinate at lower temperatures than others.

Evidence was needed to show that equally infected strains of corn were not equally injured by Basisporium seed-rot when planted at the same temperature. Accordingly, an experiment was conducted in the field in 1930 in which 11 strains of Basisporium-infected seed and 5 strains of non-infected seed were used. It was impossible to choose 11 strains that were equally infected; but all of the kernels in each lot appeared to be infected. As indicated in previous experiments, the benefit from seed treatment was used to measure the severity of injury by the organism. (Tables XIV and XV.)

The data in tables XIV and XV show that certain strains of Basisporium-infected seed corn planted at the same time and place are injured more than others. The comparative injury is not shown directly by the data but by the benefit to stands by seed treatment, which, in this experiment varied from 11.4 to 100 percent. Certain strains of seed corn were injured very little by *Basisporium gallarum* after planting and showed that practically all the injury caused by the organism had occurred in the ear-rot stage. Under the same conditions, other strains were severely injured by the organism after planting. On the average, field stands and yields from uninfected seed lots were benefited little (4.9 and 1.4 percent, respectively) by seed treatment, but stands from infected seed lots were increased 29.6 percent and yields 18.7 percent. Previously, the data had shown that severe Basisporium seed-rot was associated with cold

TABLE XIV. FIELD STANDS AND YIELDS FROM 11 NONTREATED AND TREATED STRAINS OF OPEN-POLLINATED INBREDS* INFECTED WITH *BASISPORIUM GALLARUM* PLANTED MAY 12, 1930. AMES, IOWA.

Strains of open-pollinated inbred Basisporium-infected seed*	Percentage of ears infected with Basisporium in 1929	Nontreated		Percentage increase in stand following treatment	Yield in pounds	
		Number plants from 225 kernels	Percentage stand		Nontreated	Treated
831 (spores) ...	68	75	33.3	100.0	8.7	19.7
831 (no spores).	68	72	32.0	47.2	15.0	18.7
925	88	135	60.0	43.7	33.2	34.8
1101	35	114	50.7	32.4	19.2	24.1
535	86	72	32.0	29.2	15.2	17.4
968	91	164	72.9	26.2	22.8	33.5
1001	70	169	75.1	24.8	20.4	23.0
968	91	151	67.1	22.5	23.3	23.1
945	88	137	60.9	20.4	15.6	16.6
957	93	148	65.8	13.5	18.5	22.5
377	60	149	66.2	11.4	21.9	20.4
Total nontreated		1386			213.8	
Total treated ...		1796				253.8
Total increase percentage ...				29.6		18.7

* Each strain came from an inbred row of corn which was allowed to be open-pollinated on the year selected.

TABLE XV. FIELD STANDS AND YIELDS FROM FIVE APPARENTLY HEALTHY NONTREATED AND TREATED STRAINS OF OPEN-POLLINATED INBREDS PLANTED MAY 12, 1930. AMES, IOWA.

Strains of open-pollinated inbred apparently healthy seed	Percentage of ears infected with Basisporium in 1929	Nontreated		Percentage increase following treatment	Yield in pounds	
		Number plants from 225 kernels	Percentage stand		Nontreated	Treated
368	..	189	84.0	10.0	20.4	20.0
363	0	179	79.5	5.6	22.4	22.9
468	0	191	84.9	5.2	22.3	25.6
1005	91	196	87.1	3.6	20.8	20.6
541	0	206	91.5	0.5	30.5	28.9
Total nontreated		961			116.4	
Total treated ...		1008				118.0
Total increase percentage ...				4.9		1.4

soil temperatures. Now, the data in tables XIV and XV show that certain strains of Basisporium-infected seed almost escape injury under these adverse conditions.

It was thought that a study of the germinability of these seed lots at low temperatures might show correlations between characters of the host and results of infection. Therefore, cheese-cup sand-cultures from lots of seed corn were exposed to three temperature conditions: (a) 100 kernels of each lot at room temperature (approximately 25°C.), (b) 50 kernels of each lot in a 14.5°C. cold chamber, and (c) 50 kernels of each lot in a 9°C. cold chamber. The seed lots were the same as four of the seed lots used in the field experiment from which the data were presented in tables XIV and XV. Lot 1005 was apparently free from disease, lots 968 and 957 almost invariably had spores of *Basisporium gallarum* on the kernel tips, and lot 831 was likewise diseased but the kernels had only discolored tips without spores. The purpose was to determine which lots germinated best at low temperatures and the relation of this character to

TABLE XVI. GERMINATION OF FOUR STRAINS OF SEED CORN AT LOW TEMPERATURES IN RELATION TO BENEFITS FROM SEED TREATMENT. AMES, IOWA, 1930.

Strain and condition	Germination at 25° C.	Germination on basis of live kernels at			Increase in field stand from seed treatment
		25° C.	14.5° C.	9° C.	
	Percent	Percent	Percent	Percent	Percent *
1005 N. D. F.	93	100	93	69	3.6
957 Bas. inf.	89	100	79	79	13.5
968 Bas. inf.	88	100	61	39	26.2
831 Bas. inf.	74	100	49	0	47.2

* Data from tables XIV and XV.

injury by *B. gallarum*. The data presented in table XVI indicate that Basisporium-infected seed corn in cold soils is benefited by seed treatment inversely to its ability to germinate at low temperatures.

The data in table XVI show that the seed lots tested at 25°C. contained from 7 to 26 percent dead kernels which may be considered as injury occurring before the seed was planted. Therefore, germination percentages at the different temperatures deal only with the indicated number of live kernels in each lot. At 14.5°C. the germination of live kernels in the four lots ranged from 93 to 49 percent. At 9°C. the range was from 79 to 0 percent. The benefit from seed treatment of diseased seed decreased in proportion to the ability of the seed to germinate at low temperatures. Three apparently equally infected strains, lots 957, 968 and 831, germinated in the field at the same temperature, were not equally injured. The data indicate that the early injury by *Basisporium gallarum* follows inability of a strain of corn to germinate at low temperatures, but the data are subject to other interpretations because no disease-free seed lots of the same strains were available for the trials.

The total effect on yield and field stands of planting seed corn infected with *Basisporium gallarum* was determined by making comparisons with the yields of nearly disease-free seed corn selected from the same lots of seed. Lower yields from the infected seed may be caused by such things as (a) injury to the seed resulting in loss of vigor or viability during maturity or in winter storage, (b) injury to the seed at time of germination, and (c) injury to the growing plants. Seed corn only slightly infected with *B. gallarum* often germinates at high temperatures as vigorously as disease-free seed, but the badly infected seed used in these field experiments usually tested in viability about 80 percent of that of the nearly disease-free seed. The method used to determine the injury by the organism at the time of germination was to treat part of the infected seed to inhibit or kill the fungus.

Laboratory experiments, presented above, showed that temperature is an important factor in seed rotting and prevention of seed germination by *Basisporium gallarum*.

Table XVII presents data on field stands and yields from Basisporium-infected seed planted in warm soil. Under these conditions nearly all the injury to the seed is done previous to planting.

The results of the experiment recorded in table XVII show that the field stand from nearly disease-free seed was 24.5 percent greater than from Basisporium-infected seed selected from the same lot of corn. The results also indicate that nearly all of the injury to the infected seed occurred before planting, because

planting was made in warm soil and seed treatment increased the field stand from the infected seed only 1.4 percent. Although not significant the average yield from the nearly disease-free seed was 3.1 bushels more than from the diseased seed. The warm soil temperature probably explains why little injury from infection of the seed occurred after planting.

TABLE XVII. EFFECT OF USING SEED CORN INJURED BY INFECTION WITH *BASISPORIUM GALLARUM* WHEN MATURING AND IN STORAGE AS SHOWN BY COMPARISON WITH THE FIELD PERFORMANCE OF NEARLY DISEASE-FREE SEED. AMES, IOWA, 1928.

Replication	Basisporium-infected and nearly disease-free seed				Basisporium-infected seed corn			
	Mean number of plants per hill		Acre yield, bushels		Number of plants per hill		Acre yield, bushels	
	Bas.	N.D.F.	Bas.	N.D.F.	Non-treated	Treated	Non-treated	Treated
1	1.45	1.90	49.3	74.4	1.65	1.40	61.1	58.4
2	1.85	1.85	72.5	58.9	1.25	1.50	38.9	60.5
3	1.70	1.90	66.1	57.3	1.50	1.40	57.1	50.9
4	1.45	1.95	55.5	68.5	1.40	1.45	54.7	46.9
5	1.30	1.90	51.2	62.1	1.50	1.40	52.5	57.3
6	1.35	1.85	56.8	54.4	1.50	1.65	54.9	43.5
7	1.65	1.95	62.9	55.5	1.45	1.55	53.3	54.7
8	1.40	1.85	57.1	52.5	1.40	1.40	50.9	48.0
9	1.60	1.80	18.9	29.9	1.30	1.35	49.3	48.3
10	1.30	1.85	51.2	59.2	1.40	1.50	50.9	56.0
Mean	1.51	1.88	54.2	57.3	1.44	1.46	52.4	52.5
Percentage increase		24.5		5.7		1.4		0.2

Tables XVIII and XIX present data to show the effect of planting Basisporium-infected seed corn in cold soil. Under these conditions further injury occurs after planting.

The data in tables XVIII and XIX show that more injury was caused by *Basisporium gallarum* in 1927 and 1929 when the infected seed corn was planted in cold soils than in 1928 (table XVII) when infected seed was planted in warm soil. In addition to the seed injury caused before planting, further injury occurred after planting as indicated by the percentage increases in field stand (21.5, 24.2 and 14.3) and acre yield (22.3, 11.1 and 12.0) following seed treatment. Yields from nearly disease-free seed were 16.5, 4.6 and 13.4 bushels per acre more than from Basisporium-infected seed.

These data (tables XVII, XVIII and XIX) show that nearly disease-free seed was better than Basisporium-infected seed whether planted in warm soil or cold soil; but the difference between the performances of the two types of seed was much greater when the seed was planted in cold soil. If the diseased seed lots had not been so heavily infected with *Basisporium gallarum* there probably would have been even less difference

TABLE XVIII. FIELD STANDS AND ACRE YIELDS FROM BASISPORIUM-INFECTED, NEARLY DISEASE-FREE, AND DIPLODIA-INFECTED SEED CORN PLANTED IN A COLD SOIL. AMES, IOWA, 1927.

Treatment	Mean number of plants per hill				Acre yield in bushels			
	Rate-2 kernels Bas.	Rate-3 kernels Bas.	Rate-2 kernels N.D.F.	Rate-2 kernels Diplodia	Bas. 2 kernels	Bas. 3 kernels	N.D.F. 2 kernels	Dip. 2 kernels
Check	1.3	1.9	1.8	1.2	20.6	32.5	37.1	29.0
Bayer dust	1.6	2.3	1.9	1.5	26.4	37.0	38.1	37.0
Merko	1.6	2.4	1.9	1.5	24.9	36.9	38.9	36.0
Sem. Jr.	1.6	2.4	1.9	1.6	25.8	35.3	36.8	37.3
Sterocide (double strength)	1.5	2.3	1.9	1.4	23.6	34.1	37.9	34.6
E2C+	1.6	2.4	1.9	1.4	25.1	37.2	40.0	36.2
Check	1.3	1.9	1.8	1.2	20.6	32.5	37.1	29.0
Treatments av.	1.58	2.36	1.90	1.48	25.2	36.1	38.3	38.2
Percentage increase from treatment	21.5	24.2			22.3	11.1		

in acre yields in 1928. Under warm soil conditions, such as prevailed in 1928, seed lightly infected with *B. gallarum* probably would yield almost as much as nearly disease-free seed. On the other hand, losses from Basisporium-infected seed are significant when plantings are made in cold soils, and although the losses are reduced by seed treatment, the Basisporium-infected

TABLE XIX. FIELD STANDS AND ACRE YIELDS FROM BASISPORIUM-INFECTED, NEARLY DISEASE-FREE, AND DIPLODIA-INFECTED SEED CORN PLANTED IN A COLD SOIL. AMES, IOWA, 1929.

Treatment	Mean no. plants per hill			Acre yield in bushels		
	Bas.	N. D. F.	Diplodia*	Bas.	N. D. F.	Diplodia
Check	1.1	1.9	2.2	48.9	68.2	61.4
Sterocide (¾ strength)	1.4	1.9	2.2	63.0	67.3	62.6
Sem. Jr.	1.4	1.9	2.3	58.6	67.2	65.9
Merko	1.4	1.9	2.5	59.4	71.5	68.9
Trial dust 575	1.5	1.9	2.4	64.9	71.4	70.0
Check	1.3	1.8	2.0	54.9	66.4	58.5
Hg0 —5%	1.4	1.8	2.2	61.4	67.6	65.1
Hg0 —3%	1.4	1.8	2.1	57.6	66.4	61.7
Hg(CN)2 —3.5%	1.5	1.9	2.3	63.4	66.6	65.6
58d	1.4	1.9	2.3	58.3	69.8	64.6
Check	1.4	1.8	2.1	59.2	68.6	59.7
Check average	1.26	1.85	2.09	54.3	67.7	59.9
Treatments av.	1.44	1.87	2.29	60.8	68.5	65.6
Best treatment	1.52	1.93	2.41	64.9	71.5	70.0
Percentage increase from treatment	14.3			12.0		

* Planted 3 kernels per hill, others 2 kernels per hill.

seed is not equal to nearly disease-free seed. Furthermore, Basisporium-infected seed is not benefited by seed treatment as much as Diplodia-infected seed (tables XVIII and XIX).

CAUSE OF RESISTANCE IN SEEDLING STAGE

As previously stated, *Basisporium gallarum* does not cause typical seedling blight, but injures the seed by ear infection in the fall or by seed-rotting in the spring during the interval between planting and germination. Basisporium-infected seed corn is severely injured if this interval is of long duration as when the seed is planted in cold soil. If the interval is short, it seems that the organism does not have time to injure the developing embryo before it becomes resistant to its attack. Data presented later in this paper on the correlation of cob reaction (pH value) with resistance and susceptibility to Basisporium infection have given a basis for a further interpretation of this seed-rotting phenomenon. In the dry corn kernel the endosperm and cell contents of the embryo are alkaline or neutral. After germination the cells of the scutellum are distinctly acid, but the endosperm remains alkaline (19). Low soil temperatures do not prevent the imbibition of water which promotes the growth of *B. gallarum,* but they do prevent germination of the seed and, therefore, the development of acidity of the embryo. Later it will be shown that acidity of the cob is correlated with resistance to Basisporium infection. Therefore, the acidity of the embryo during active germination may be correlated with resistance to this organism and explain why Basisporium seedling blight seldom or never occurs. The neutrality of the embryo preceding active germination may explain why seed rotting takes place when Basisporium-infected seed corn is planted in cold soils.

Table XX shows the hydrogen ion concentration of embryos of seed corn placed under conditions for germination at cold and warm temperatures.

TABLE XX. REACTION OF EMBRYOS INCLUDING PART OF SCUTELLUM DURING GERMINATION. AMES, IOWA, 1933.

Time on germinator days	Temperature		
	9° C. pH	28° C. pH	22° C. pH
0 dry	6.8	—	—
1	—	6.4	6.6
2	6.6	6.2	—
3	—	5.7[1]	6.2
4	6.4	—	5.6[2]
5	6.4	—	5.4[3]
6	6.4	—	5.3[4]
7	5.8	—	—
9	6.4	—	5.4

1 Plumules ⅛ to ½″ = pH 5.6 and roots pH 5.8.
2 Plumules ⅛ to ½″ = pH 5.7 and roots pH 5.5.
3 Plumules pH 5.4 and roots pH 5.4.
4 Plumules pH 5.2 and roots pH 5.2.

The data in table XX show that at warm temperatures the embryo rapidly becomes acid, while at a cold temperature there is little change in reaction of the embryo over a long period.

Several experimenters have tried to find a positive correlation between hydrogen ion concentrations, and infections caused by certain parasitic organisms such as rusts and smuts. All the results coming to the writer's attention have been negative except those of Tropova (22) published in Russian with a short English summary as follows:

"The author tries to find a correlation between the grades of susceptibility to fungous infection and the hydrogen ion concentration of the cell sap and comes to the following conclusions:

"1. The active acidity of different organs of one and the same plant is not identical (the pH value of the bunch (cluster) of the castor plant amounts to 5.8; that of the stalk—5.4; that of the leaf—6.4). This fact appears, as it seems, to be one of the factors for the adaptation of the fungous parasite to befall determined plant organs. (*Fusarium ricini* Bereng infects only the cluster of the castor plant.)

"2. Different varieties and forms of the castor plant do not show the same acidity of cell sap.

"3. In artificial and natural environmental conditions the grade of the susceptibility of the castor plant to the infection with *Fusarium ricini* Brg. varies in connection with the change in the pH value of the cell sap (from an acid to an alkaline pH, 5.53-6.91 pH).

"4. The moment of the infection with the fungous parasite is adapted to a determined pH value of the cell sap in the given plant. According to the growth and development of the castor and the kenafe plants, the hydrogen ion concentration of the cell sap changes from an acid to an alkaline reaction.

"5. The percentage relation of the susceptibility of other cultures to fungous and bacterial infection varies, as it seems, also in connection with the pH value of the cell sap.

"6. A strong development of some microorganisms is observed in connection with the change of the pH value toward acidness; other organisms develop with the shifting of that value toward alkalinity.

"7. In the selection of varieties, which are resistant to diseases, the determination of the pH value of the cell sap may play the part of one of the symptoms, on which such a selection must be based.

"8. The possibility of applying some outer effects to the plants (as fertilizers, selection of soil type, etc.), which may influence the pH values of their cell sap and thereby also their resistance to fungous diseases, is not excluded as a means of control against fungous parasites."

BASISPORIUM EAR-ROT

Basisporium ear-rot is a very common disease of dent corn in Iowa. Seed lots often contain high percentages of the infected kernels, probably because the potential damage from seed infection is not appreciated by the corn grower. The kernels germinate well at the high temperatures of the ordinary germination tests and the fungus is inconspicuous under these conditions. Advice to test on slow, cold germinators would be so unacceptable as to be of little service. A high percentage of the infected kernels can be eliminated by selecting only ears that make clean white breaks from the shanks when husked, and therefore, show neither high coloration nor shredded condition at the butt of the cobs.

Ten composite samples of corn from different cribs were sent to the Botany Department of Iowa State College for viability and disease analysis. On the results of these analyses, one crib of corn was to be chosen from which to select seed corn. The tests showed the distribution of Basisporium as compared with the other common diseases of seed corn. The data are presented in table XXI.

TABLE XXI. GERMINATOR ANALYSIS OF 10 LOTS OF CORN GROWN IN 1929 AND TESTED IN 1930. AMES, IOWA.

Lot no.	Condition of 50-kernel lots of seed corn				
	Basisporium-infected	Gibberella-infected	Diplodia-infected	Apparently healthy	Dead
	No.	No.	No.	No.	No.
1	15	6	7	15	7
2	8	7	6	23	6
3	3	0	2	45	0
4	16	1	2	29	2
5	12	0	2	34	2
6	4	8	2	29	7
7	8	1	5	22	14
8	12	0	7	23	8
9	2	3	3	36	6
10	14	0	3	28	5
Total	94	26	39	284	57
Percentage	19	5	8	57	11

The data in table XXI show that, for these 10 lots of corn grown in 1929, 19 percent of the kernels were infected with *Basisporium gallarum* which was more than the combined percentages of infections with both *Diplodia zeae* and *Gibberella saubinetii.* Observations, however, have indicated that in very dry seasons *Diplodia zeae* causes more ear-rot than *B. gallarum.*

Basisporium gallarum usually infects the ear by way of the shank, but some strains of dent corn are especially susceptible to infection of the tip of the ear. In either case the invasion of the fungus may extend ultimately to all or to large portions of the ear, but in certain instances the invasion seems to be definitely

limited to the soft portion of the tip. Open-pollinated inbred 1005, on which data were presented in tables XV and XVI, furnishes an example of this type of infection. Ninety-one percent of the ears in this line had the limited type of ear-tip infection, but the seed seemed healthy both on observation and in field trials in which the stand was benefited only 3.6 percent by seed treatment. Infected seed in the same expriment (table XIV) was benefited on the average 29.6 percent.

INOCULATION EXPERIMENTS

Preliminary experiments in 1927 and 1928 on inoculation of the shanks and tips of ears with spores of *Basisporium gallarum* gave negative results, because as many diseased ears developed in the check plots as in the inoculated ones. At the same time similar inoculations with *Diplodia zeae* gave positive results.

In 1929 ground naturally-infected cob was used as the inoculum for insertion in the ear shanks on Sept. 7. To test the effect of broken ear shanks on subsequent natural infection with *Basisporium gallarum,* 500 shanks were artificially broken on Sept. 7. The ears were harvested and examined on Oct. 22. The data are shown in table XXII.

TABLE XXII. BASISPORIUM INFECTION ON OCT. 22 OF EARS OF YELLOW DENT CORN FROM PLANTS RECEIVING NO TREATMENT (CHECK), FROM PLANTS HAVING THE SHANKS BROKEN ON SEPT. 7, AND FROM PLANTS WITH SHANKS ARTIFICIALLY INOCULATED ON SEPT. 7, 1929, AT AMES, IOWA.

Treatment	Total number of ears	Infected ears					
		Spores visible		Spores absent		Total	
		No.	Pct.	No.	Pct.	No.	Pct.
Check	455	32	7.0	92	20.2	124	27.3
Broken shanks	506	62	12.3	71	14.0	133	26.3
Artificially inoculated ..	499	84	16.8	88	17.6	172	34.5

The data in table XXII indicate that at the time of examination, Basisporium ear-rot was significantly more advanced, where the shanks were broken or artificially inoculated, than in the check. This was shown by the greater number of ears on which the fungus had sporulated. The total number of ears showing Basisporium ear-rot, however, was not significantly different in the case of broken shanks, but was increased where artificially inoculated.

RELATION OF COB REACTION TO BASISPORIUM EAR-ROT

In the fall of 1928 Dr. M. T. Jenkins[2] reported that in making F1 seed of a certain high-yielding cross, the ears on which the F1

[2] The author is much indebted to Dr. M. T. Jenkins, in general charge of the Corn Improvement Program of the Farm Crops Subsection of the Iowa Station, for the inbred strains of corn used in these studies.

seed was borne were so rotten that they almost invariably could be crushed in one hand. On examination of these ears, Jan. 10, 1929, it was found that the condition was caused by Basisporium infection. Out of the large number of ears of this particular cross which were examined, two were found which apparently had escaped infection and these were brought to the laboratory.

In seeking an explanation of why the fungus grew on these cobs more readily than on cobs of open-pollinated strains of corn, it was thought well to attempt to repeat the phenomenon under pure culture conditions. A cob-meal agar medium was prepared by grinding the two apparently disease-free cobs in a Wiley mill to about the fineness of granulated sugar, adding enough 1 percent water agar to bind the meal, and autoclaving the tubed medium at 15 pounds pressure for 20 minutes. A similar medium was made from a composite of cobs from open-pollinated corn. Tubes of each medium were inoculated with a pure culture of *Basisporium gallarum*. The organism grew more profusely on the medium made from susceptible cobs. The difference in amount of growth at 25°C. was very apparent by the end of 3 days.

The next step was to find out why the organism grew more profusely on the one medium than on the other. The simplest reason that could be thought of at the time was the acid or alkaline reaction of the media. Colormetric tests showed that the medium from susceptible cobs had a pH value of 6.2 while the other medium had a pH value of 5.4.

Whether or not the cob reaction is the fundamental reason for resistance and susceptibility of corn to Basisporium ear-rot, it was considered advisable to determine the correlation of cob reaction to infection. Before beginning these correlation studies, it was necessary to decide upon a method for testing the cob reaction and to determine how much it could be varied without affecting the results.

Ten cobs from an open-pollinated strain of corn and three from inbred strains were obtained. Fifteen grams from each cob, ground separately, were placed in 200 cc. of distilled water in liter Erlenmeyer flasks and allowed to soak for 16 hours. Portions for analysis were obtained by pouring the liquid through a piece of cheesecloth drawn over the mouth of the flask. The pH values for the cobs from open-pollinated corn were: 4.6, 4.6, 4.7, 4.4, 4.4, 4.6, 4.6, 4.4, 4.9 and 4.5. The pH values for the cobs from inbred lines were 5.3, 5.2 and 5.7.

Ten cobs from an inbred were ground separately and 15 grams of each placed in 200 cc. of distilled water. The pH values of five cobs were determined after 2½ hours and were as follows: 4.8, 4.7, 4.8, 4.9 and 4.8. The other five cobs were tested after 20 hours and were as follows: 4.7, 4.8, 4.7, 4.8 and 4.8.

These illustrate the tests which indicated that cobs from inbred lines were more uniform in reaction than cobs from open-

pollinated strains and that readings could be satisfactorily made after a few hours soaking. Cobs from 71 inbred lines were tested using different times of soaking, ranging from 2 to 23 hours. For those tested within 2 to 16 hours after placing the cob meal in the water, the pH values of the different inbreds ranged from 4.5 to 5.6. Long soaking seemed to give greater hydrogen ion concentrations, possibly because of fermentation (see table XXIII).

TABLE XXIII. HYDROGEN ION CONCENTRATION IN DISTILLED WATER EXTRACTS OF COB MEAL FROM INBRED LINES OF CORN.

Crossing-block number	pH after:	
	2-hour extraction	23-hour extraction
467	5.6	5.0
468	4.8	4.2
469	4.6	4.2
470	5.2	4.2
471 (red cob)	4.7	4.2
471 (white cob)	4.7	4.1
472	5.0	4.1
473	4.8	4.6
Mean	4.9	4.3

Two hundred fifty grams of cob meal were made from cobs of inbred 489, and 10-gram portions were placed in flasks with 130 cc. of distilled water. These portions were treated in different ways to determine the effect on the pH values (see table XXIV).

TABLE XXIV. HYDROGEN ION CONCENTRATIONS OF DISTILLED WATER EXTRACTS OF COB MEAL FROM AN INBRED LINE OF CORN.

Treatment of each portion	pH
Soaked 20 minutes at 25° C.	5.2
Soaked 1 hour at 25° C.	5.2
Soaked 18 hours at 20° C.	5.2
Boiled 5 minutes and cooled to 25° C.	5.2
Boiled 15 minutes and cooled to 25° C.	5.2
Boiled 25 minutes and added 130 cc. distilled water	5.4
Boiled 25 minutes, added 130 cc. distilled water and boiled filtrate 2 minutes	5.3
Autoclaved at 25 pounds for 15 minutes	5.0

The data in table XXIV show that the cob meal extract was fairly stable. On the basis of these tests, all determinations during the years up to 1932 were made after the cob meal had soaked ½ to 2 hours.

It was stated above that hydrogen ion determinations were made on cobs from 71 inbred lines grown in 1928. Progeny of several of these lines were grown in 1929 on which the percentage of ears infected with *Basisporium gallarum* was recorded. The relation of the cob reaction of these inbred lines to Basi-

sporium ear-rot in the progeny of the same lines grown the following year is shown in table XXV.

TABLE XXV. HYDROGEN ION READINGS OF COBS OBTAINED IN 1928 FROM INBRED LINES AND BASISPORIUM EAR INFECTION DATA OBTAINED IN 1929 ON EAR ROWS FROM THESE LINES.

1928 Crossing-block number	pH reading	1929 inbreds		
		No. ears observed	Infection	
			Number	Percent
407	4.6	36	0	0
418	4.6	65	0	0
419	4.8	108	1	0.9
428	4.6	71	2	2.8
429	4.7	11	2	6.9
"	"	18	0	
449	4.6	36	0	0
450	4.7	7	4	17.0
"	4.7	6	4	
"	"	11	0	
"	"	23	0	
Total		392	13	3.3
435	5.2	19	13	68.7
486	5.4	63	14	22.2
489	5.2	31	6	19.4
Total		113	33	29.2

The cobs in the first group in table XXV were higher in acidity than those in the second group, and the high acidity of the cobs seemed to be correlated with resistance to Basisporium ear-rots (3.3 percent infected). The cobs in the second group were less acid, and 29.2 percent of the ears of the progeny were similarly rotted. Number 450 in table XXV had four progenies in the 1929 planting, two of which seemed susceptible while the other two were resistant. These data indicate that this inbred line was still segregating for the character of Basisporium ear-rot resistance. Probably the same could be said for number 429.

These indications, that cob reaction and resistance and susceptibility to *Basisporium gallarum* were heritable characters, led to a cooperative project between the departments of Botany and Genetics. Mr. Kenneth Kopf made the following report of progress under this project in the 1932 Annual Report of the Botany and Plant Pathological Section of the Iowa Station (7):

"Continued work on resistance of corn to infection by *Basisporium gallarum* using inbreds, F1, and backcrosses of differentially susceptible lines has shown the resistance to be dominant. The accompanying table, which gives summarized data on two of the lines and their crosses, shows this fact plainly. The correlation of acidity of mature cob and resistance to Basisporium infection still appears relatively high and positive, although there are some indications that date of planting, growth rate,

and cob hardness also influence the degree of infection for a given season. Data show that resistance to Basisporium ear-rot is dominant.''

Line	Total* plants	Number healthy	Basisporium infected plants	Av. pH of healthy cobs	Range in pH of healthy cobs
R (resistant) ..	26	19	1	4.67	4.6–4.8
S (susceptible) ..	53	7	36	5.55	5.1–5.7
RxS	17	11	2	5.03	4.9–5.2
(RxS)xR	87	84	1	4.83	4.4–5.6
(RxS)xS	82	48	12	5.42	4.8–6.6

* "The discrepancy between second column and sum of third and fourth columns is due to presence of other saprophytic and parasitic fungi. pH readings taken on those cobs judged to be free from disease after inspection of cob under 75X magnification."

In 1929, 82 inbred lines of corn were examined for presence of ear-rots. Fifty-two of these inbred lines were inoculated the second week in September with ground Basisporium-infected cob. Healthy cobs from each inbred line were brought to the laboratory for pH value determinations. The data from these experiments are presented in tables XXVI and XXVII.

TABLE XXVI. HYDROGEN ION READINGS OF APPARENTLY HEALTHY COBS AND OF NATURAL BASISPORIUM EAR INFECTIONS OF INBRED LINES OF CORN. AMES, IOWA, 1929.

Row no. inbred	Number ears observed	Number infected ears	pH reading cob	Other ear infections noted
7	25	4	5.8	
21	20	0	4.8	5 Gibberella+1 Diplodia
26	15	7	5.7	
29	24	5	6.0	1 Diplodia+4 smut
30	35	5	6.2	5 Diplodia
40	31	1	4.9	
44–1 }	19	7	{ 5.2	
44–2 }			{ 5.2	
46	27	7	5.2	
48	28	8	4.9	1 Diplodia+1 Gibberella+1 smut
50	23	0	4.8	1 Diplodia+1 smut
52	27	11	5.9	2 Diplodia+2 Gibberella+7 smut
54	36	19	5.8	2 Diplodia+4 Gibberella+2 smut
57	26	12	5.6	1 Gibberella+1 smut
60	17	4	5.7	1 Diplodia+1 Gibberella+2 smut
61	20	0	5.2	1 Diplodia+1 Gibberella+1 smut
69	28	0	5.0	1 smut
70	19	0	4.8	
86	24	0	5.0	
107	16	0	5.2	1 Diplodia+1 smut
113	25	4	5.2	
116	14	0	5.0	
119	24	8	5.6	
123	25	7	5.4	
130	23	0	4.4	
136	15	0	4.8	
142	20	0	4.4	
161	23	8	5.4	1 Diplodia
164	24	0	4.7	
192	29	4	5.0	
197	26	0	4.9	

TABLE XXVII. HYDROGEN ION READINGS OF APPARENTLY HEALTHY COBS, AND OF EAR INFECTION WITH *BASISPORIUM GALLARUM* OCCURRING NATURALLY AND FOLLOWING ARTIFICIAL SHANK INFECTION OF INBRED LINES OF CORN. AMES, IOWA, 1929.

Row no. inbred	Uninoculated		Inoculated		pH reading cob	Other ear infections noted
	Number ears	Number infected	Number ears	Number infected		
363	4	0	14	0	4.9	
368	8	0	10	0		
377	5	3	10	6	5.6	1 Diplodia
415	1	0	6	0		
422	4	0	33	5	5.4	1 "
431	5	4	13	9	5.4	
441	5	2	10	2	5.7	1 Gibberella
469	4	0	16	0	5.8	
519	7	4	18	1		
535	8	8	14	11	5.6	
541	7	0	21	0	4.6	
569	6	0	8	0	5.2	5 Diplodia
581	8	2	19	2	5.2	
598	6	4	23	11	5.8	
622	6	1	19	6	5.1	
633	6	1	14	1	5.2	
662	0	0	19	1	5.0	
665	5	1	20	0	5.1	3 undetermined
667	6	0	21	0	5.3	
684	5	1	6	1		
750	5	3	14	11		
799	4	0	10	4	5.4	6 undetermined
803	5	2	23	6	5.8	5 " +1 Diplodia
804	6	0	25	2	5.5	5 Diplodia
811	6	0	13	1	5.4	2 Diplodia
831	5	3	17	12	5.2	
837	4	0	18	0	5.2	
854	7	6	12	10		
865	5	0	16	0	4.7	
884	8	0	19	3	4.8	
891	5	0	15	0	6.2	4 Diplodia+2 Gibberella
893	5	0	17	2	5.6	3 Diplodia+3 Gibberella
896	5	0	19	5	5.0	
905	2	0	11	3	4.9	Infection slight
915	4	0	12	3	5.2	
925	5	5	12	10	5.2	
936	6	4	16	13	5.4	
945	5	5	21	18	6.2	
957	8	8	19	17	6.3	
968	5	5	18	16	6.1	
973	6	0	11	0	4.8	
987	4	2	3	2	5.4	
993	3	2	3	2	5.2	
1001	5	3	25	19	5.6	
1005	6	6	26	23	5.4	
1034	5	0	19	1	4.9	
1074	3	0	13	0	4.9	
1101	5	0	12	6	5.4	
1105	5	1	13	4	5.9	
1107	5	0	11	0	4.9	
1110	3	0	11	2	5.2	
1113	5	1	12	3	5.4	
Total	266	87	800	254		
Infection percentage		32.7		31.8		

The data in table XXVII show that inoculations with ground Basisporium-infected cob into the ear shank under the conditions of this experiment did not significantly increase or decrease the percentage of Basisporium-infected ears. It appeared that there was sufficient natural inoculum to infect the susceptible ears and that even the insertion of the inoculum, by wounding, did not cause infection of the resistant ears.

On the other hand, in 1932 when approximately only one-fifth as much Basisporium ear infection occurred naturally in inbred lines (table XXVIII), ear infection in 48 inbred lines was increased significantly by artificial infection from 6 percent to 9 percent.

TABLE XXVIII. DISEASE READINGS OF EARS FROM INBRED LINES OF CORN GROWN AT AMES, IOWA, 1932.

Condition of ears	Experiment I		Experiment II		Experiment III			
	Ears		Ears		Check		Basisporium inoculated	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Healthy	2231	67.4	1779	58.3	867	60.6	658	54.5
Basisporium-infected	191	5.8	230	7.5	86	6.0	109	9.0
Diplodia-infected	550	16.6	383	12.5	176	12.3	157	13.0
Infected with other organisms	338	10.2	659	21.6	301	21.0	282	23.4

A partial analysis of the remainder of the data in tables XXVI and XXVII is shown in summary table XXIX.

TABLE XXIX. SUMMARY OF DATA FROM TABLES XXVI AND XXVII.

Cob pH	Inbreds in class interval	Inbreds infected		Ears observed	Ears infected
	No.	No.	Percent	No.	Percent
4.4–4.7	5	0	0	116	0
4.8	6	1	17	121	2.5
4.9–5.0	14	7	50	312	7.4
5.1–5.2	16	12	75	313	22.7
5.3–5.4	12	11	92	258	38.0
5.5–5.6	7	7	100	175	41.7
5.7–5.8	8	7	88	185	33.5
5.9–6.3	7	6	86	173	48.6

Table XXIX shows that hydrogen ion concentrations in distilled water extracts of cobs from 75 inbred lines of corn varied with the inbred lines from pH 4.4 to pH 6.3. Susceptibility to Basisporium ear-rot was directly correlated with low acidity and resistance with high acidity. There was not a single Basisporium-infected ear in the group composed of cobs reading pH 4.4 to 4.7. Nearly half (48.6 percent) of the ears in the group pH 5.9 to 6.3 showed infection with *Basisporium gallarum.*

Thirty-eight inbred lines were grown in 1932 on which disease readings were made and hydrogen ion concentrations of the mature cobs determined. A number of cobs were sawed lengthwise into halves. One half of each cob was prepared for analysis by grinding as was done in all previous experiments. In each case the ground half of the cob and its unground half were soaked in flasks of distilled water for 2½ hours. Hydrogen ion values for each half cob were identical regardless of whether the cob was ground. Individual pH readings without grinding the cobs were recorded for 10 apparently healthy cobs from each of the 38 inbred lines. An analysis of these data is presented in table XXX.

TABLE XXX. HYDROGEN ION READINGS OF APPARENTLY HEALTHY COBS AND NATURAL BASISPORIUM EAR INFECTIONS OF INBRED* LINES OF CORN. AMES, IOWA, 1932.

Cob pH	Inbreds in class interval	Inbreds infected		Ears observed	Ears infected
	No.	No.	Percent	No.	Percent
4.40–4.59	5	1	20	410	0.25
4.60–4.79	7	2	29	543	0.74
4.80–4.99	7	4	57	667	1.50
5.00–5.19	7	3	43	464	1.10
5.20–5.39	9	8	89	873	11.60
5.40–5.79	3	3	100	248	29.80

* Inbred lines were obtained from Dr. E. W. Lindstrom, head of the Genetics Department, Iowa State College.

The data in table XXX confirm the results obtained in 1929 (table XXVII) in that susceptibility to Basisporium ear-rot was directly correlated with low acidity and resistance with high acidity. The data in tables XXVI, XXVII, XXIX and XXX indicate that the critical point is near pH 5.2. In general when the cobs were more acid than pH 5.2, very few ears in those inbred lines were infected, while many ears were infected in those inbred lines whose cobs averaged less acid than pH. 5.2.

DISCUSSION

Corn disease control measures fall far short of our desires both as to adequacy and acceptability. Proper crop rotations give a measure of control, but on the average all of the farmland of Iowa is occupied half of the time by corn. Great effort has been put forth during the past 10 years to teach the value of ear-testing, yet less than one-tenth of the corn growers in Iowa ear-test their seed corn. Seed treatment is a recent offering and apparently a real contribution, because more than one-third of the farmers of Iowa treat their seed corn. Seed treatment, however, is inadequate because it controls only in the seedling stage and only seed-borne diseases. We lack satisfactory advice to give for the control of the ear-rots. Nothing would be more acceptable than to offer high-yielding ear-rot resistant strains of corn. In considering the momentum that the corn breeding program has attained and the rapid advance in the education of corn growers to the use of hybrid seed, it seems probable that the next big contribution to corn disease control will come through resistant strains of corn. To hasten the time, methods must be developed which are simple, definite and consistent for the determination of disease resistance in inbred lines and crosses.

For the Basisporium dry-rot disease of corn, data have been presented which indicate that strains of corn which germinate below 11°C. are resistant to Basisporium seed-rot and that simple cob reaction (pH value) tests will strongly indicate the resistance or susceptibility of an inbred strain to the ear-rot. Moreover, the data indicate that tests on a number of cobs will determine whether or not the inbred is homozygous for the character. Because the tests do not depend on the presence of infection in the cob, they may be applied any year whether or not there is an epidemic of the disease. The greatest value in this test probably lies in the fact that the test can be applied equally well every year.

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